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author's investigation. A study of the origin of peat follows, which throws some light on the way in which coal was formed in Paleozoic times. The author's study of the structure of coal embodies the results of his examinations of a number of different Paleozoic coals. Particular attention is given to microscopic studies, many of which were made with a magnification of 1,000 diameters, approaching the limit of visibility.

The text is accompanied by 160 plates, many of which contain several illustrations,and a bibliography of publications on the composition of coal.

An enormous amount of valuable information on the composition of coal has been accumulated in this bulletin. Many side lights on plant life during the Paleozoic are brought out by the study of the spores and other morphological elements of the coal. Biologic factors like the origin of rootlets and the existence of fungi in Paleozoic times, are revealed.

There are a number of theories concerning the origin of coal, but we are yet unable to form a conclusive conception of this interesting geological process. Thiessen's paper supplies a great amount of information which brings us a step nearer to a satisfactory conception.

A. C. N.

Contact-metamorphic Tungsten Deposits in the United States. By FRANK L. HESS and ESPER S. LARSEN. United States Geological Survey, Bulletin 725-D, 1921.

Of the 5,000 tons of tungsten concentrates (reckoned as 60 per cent WO_3) produced in the United States in 1918, about 1,400 tons was in the form of scheelite ($CaWO_4$) from contact-metamorphic deposits. Most of these deposits are along the western side of the Great Basin in California and Nevada but there are scattered deposits near Great Salt Lake and in Arizona, New Mexico, and Oregon. Their development has been recent, the first of the type being discovered in 1908. During the European war most of them were active producers but by 1920 all had lapsed into idleness because of the severity of competition with imported concentrates and richer American ores, combined with the great depression in the steel industry.

The contact-metamorphic tungsten deposits are nearly all at or near the contact between quartzose igneous rocks, principally granodiorites, and limestones. In a number of districts the deposits are clustered about several small granite outcrops close together, which suggest the presence of a larger granite body beneath.

The silicate minerals are those usual in contact-metamorphic deposits, except that minerals carrying boron appear to be absent and magnetite and hematite are notably rare.

The eccentric distribution of the deposits along some igneous contacts is correlated with the presence or absence of fractures which could serve as channels for the metamorphosing solutions, but other eccentricities such as the presence of chunks of unaltered limestone in the intrusive are not readily explained. Where the intrusive rock is in contact with a large body of sediments the contact-metamorphic rocks may follow the contact rather regularly, or may replace certain beds in the sediments, or may follow fissures crossing them. Unlike many contact-metamorphic deposits which are notably compact, these commonly contain vugs some of which attain the dimensions of caves in which a man can stand upright. These are not the result of solvent action subsequent to metamorphism but were formed during metamorphism, and are characterized by crystals of quartz some of them a foot long projecting inward from their walls.

Contact metamorphism has usually affected the igneous rock as well as the limestones, but the metamorphic zone is much narrower in the intrusive than in the limestone and is much more siliceous being made up mostly of quartz with subordinate dark silicates of the same varieties that characterize the adjacent altered limestone. A distinct zoning is usually perceptible in the alteration of the limestone. The zone nearest the intrusive is characterized by dark-colored iron-bearing silicates—iron-bearing garnet, epidote, pyroxene, hornblende, etc., with calcite and quartz and minor amounts of other minerals. This zone is the chief host of the scheelite.

Beyond this zone comes a zone characterized by light-colored silicates poor in iron, tremolite and wallastonite being the commonest of these silicates. Colorless diopside, scapolite, colorless garnet, and other silicates are present in less abundance. Calcite is very abundant. Scheelite is absent. The zone of light-colored silicates grades outward into the marble that forms the outermost part of the contact-metamorphic aureole.

Evidences are present that in many of the deposits the minerals were not deposited contemporaneously, but that one mineral followed another in a regular sequence. The details of the successive replacements were not worked out microscopically, but in general it appears that garnet was one of the first to be deposited and that sulphides were among the last.

The authors propose the name "tactite" for the rocks and ores developed by contact metamorphism nearest the intrusive (Latin, *tactus*, "touch"). This term seems well chosen and may prove a convenience. It should be noted that the authors designate as "tactite" only the zone of dark silicates next the intrusive, and do not apply the term to the zone of light-colored silicates or to the marble.

No evidence of enrichment through the action of meteoric waters was noted in any of the deposits. Leaching is shallow.

The average tenor of the deposits worked near Bishop, California, is about 0.5 per cent of WO_3; ore mined in the Mill City, Nevada, district averaged about 2 per cent of WO_3.

E. S. Bastin

Geology of the Non-metallic Mineral Deposits Other Than Silicates. Vol. I. Principles of Salt Deposition. By A. W. Grabau. First edition. New York: McGraw-Hill Book Co., 1920. Pp. xvi+435, figs. 125.

This volume is a treatise on applied stratigraphy. The author designates it as "a hand-book of salt-geology," using the term salt to include phosphates, nitrates, borates, and similar deposits, as well as common salt.

The author discusses first the sea as a source of saline deposits, basing a number of his conclusions on the careful work by Van't Hoff on the famous Stassfurt deposits. This is followed by a well-illustrated chapter concerning the conditions by which sea salts are deposited in nature, emphasis being placed on their organic deposition.

In the discussion of lagoonal deposits, it is concluded that many of the older salt deposits, generally believed to have been formed after the manner postulated by the bar theory, cannot be accounted for in this way, inasmuch as they are non-fossiliferous. Lagoonal deposits, such as those forming in the Karatugas Basin, contain fossils.

A chapter is devoted to the classification of terrestrial salts, and the larger portion of the book is devoted to a discussion of their origin, method of concentration, and distribution. Throughout the book numerous salt lakes and salt basins of various types are described, and their deposits discussed.

Attention is given to the mooted questions of the origin of nitrates, phosphates, and dolomites, and the several theories which have been advanced to explain them are stated.

In the chapter on "Deformation of the Salt Bodies," the author favors the view of Rogers that the salt domes of Louisiana and Texas are of exogenetic origin, but doubts whether all the characteristics of salt domes can be accounted for without the action of endogenetic forces.